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NAVIGATION CONGRESSES

PORT OF PARA, BRAZIL

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NAVIGARE NECESSE

BRUSSELS

PRINTING OFFICE OF THE PUBLIC WORKS (CO. LTD.)

169, Rue de Flandre, 169

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1907

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PORT OF PARA, BRAZIL

At the mouth of the Amazon.

I

In writing of the proposed works recently undertaken at Para, there will be given some account of the method of port construction and operation which has become a settled policy with the General Government of Brazil, a statement of the physical and commercial features, a description of the works — the substructure, the superstructure and the facilities to be provided — and a statement relative to the commerce.

By an Act of the Parliament of the Imperial Government on October 13, 1869, provision was made for the construction and operation of the ports of the country by private companies. The Act then passed and approved by the Emperor is in force under the Republic and is the basis of all contracts made by the Executive for the building and operation of ports by private companies. Under this Act the Government is authorized to enter into those contracts which cover all constructions and operations necessary for the handling of traffic in the ports. In the law are given the general principles that should guide the Government in making the contracts, the presentation of the plans, the maximum duration of the concession, the establishment of the capital and the provision of a sinking fund for the same so that on the termination of the concession all the works may revert to the Government free of any onus whatever. The port dues to reimburse the concessionnaire (company) for its outlay are to be approved by the Government. The Company may warehouse the goods and assist the Custom House authorities in their work and the necessary rules and regulations for the same will be drawn up. The Government after ten years from the conclusion of the works may take them over by the payment of a sum of money that shall meet the

expenses incurred in their construction together with interest on the same. The works shall be built under the supervision of the Government.

Under this law, and the regulations from time to time published, the Port of Santos, south of Rio-Janeiro and the principal coffee port of Brazil, was built and is operated. The results to commerce, to the income of the Government and to the Port Company have been so satisfactory that it has become the standard at is were for the other ports which have been authorized by the Government, such as Manaos (1.000 miles up the Amazon), Bahia (north of Rio-Janeiro), Pernambuco, Para and Rio Grande do Sul (in the most southern State of Brazil) and other ports.

About two years since the author was requested to have an examination made of the conditions existing at the Port of Para and to report upon the same. As a result of this examination, a proposition was submitted to the General Government looking to the construction and operation of a modern Port. The Contract was executed in due time and after an extended study and discussion. The Contracts for the construction have been entered into, — the substructure with Messrs. S. Pearson & Son, Ltd. of London and the superstructure and facilities with Messrs. Schneider et Cie (Creusot) of Paris. The construction plans have been made and the Contractors are now engaged upon the preliminaries of their work.

A comprehension of the general situation will be quite easy by a glance at the accompanying map (No. 1) which shows Para at the outlet of the greatest river system in the world, not only in volume of waters but in the area covered by the main stream and its numerous affluents, which reach to or into the neighboring countries of Guyana, Venezuela, Colombia, Equador, Peru and Bolivia. The last two countries are more interested in the fluvial navigation for their products eastward than any other of the countries affected. Above Iquitos, 2000 miles from the mouth of the Amazon and the border port of Peru on the east, there are nearly 1000 miles more of navigation in that country, and in Bolivia nearly the whole of the country is covered with the net work of the tributaries of the Madeira and other great affluents of the Amazon. This latter country, by a recent treaty with Brazil, is importantly interested in any works that will provide facilities for the largest class of ocean vessels at Para, for Brazil is to assist Bolivia in its laudable effort to bring the great valley of the Madeira

River into connection with the outside world by means of a Railroad which will flank the Falls of the Madeira, which have until now barred the access by navigation to this valley. The relations between Brazil and Bolivia are now friendly since the treaty above referred to was made, by which for a large sum of money, given by Brazil, all boundary questions were amicably settled and the territory of Acre, very rich in india rubber, became wholly under the ownership of Brazil. It is difficult to estimate the total length of the Amazon system of navigable waters, or waters that can easily be made navigable or brought into connection with the main river and the ocean as by means of the Madeira Railroad, but the area of the water shed is about 2,973,000 square miles (7,700,000 km²) and the total length of the waterways at least 18,000 miles (29,000 km.). In this résumé is included the Tocantins River, flowing into the Para Estuary from the South and two-thirds the size of the Mississippi River, as this is really a tributary of the Amazon system since the various outlets of the Amazon have a connection during their floods.

The principal exporting product of this vast area is the india rubber, found mostly in the two States of Amazonas and Para and in the National Territory of Acre. Para is the natural exporting port of all the rubber from the State of Para and also from the Territory of Acre, as the Para merchants handle this rubber. By existing law each State controls its own exports. The coffee of Brazil is commonly looked upon as the most valuable product, but the statistics show that the value of the present annual amount of coffee exported from the whole of Brazil is somewhat over 13,000,000 pounds Sterling while the rubber product, nearly all from the Amazon Valley, is over 16,000,000 pounds Sterling and the industrial and market conditions lead always to a greater and greater product in order to supply the increasing demands of the world for this necessary material.

There should be considered in any statement of general commercial conditions that it has been only recently that the countries lying along the Andes and, like Peru, having a Pacific coast, have turned their attention to those great neglected areas lying on their Atlantic slopes. Spain, in its centuries of dominion over these countries, always insisted upon the commerce, from and to the mother country, passing over the Isthmus of Darien and up and up and down the narrow fringe of coast lands along the Pacific. The Republics of Equador, Peru and Bolivia are now more and

more planning the exploitation of their eastern slopes whose natural outlet is not westward over the mountains by laborious and costly carriage, but eastward down the great rivers to the sea at Para. Not only these outlying countries but the great state of Brazil, Matto Grosso, will find an outlet to the sea via Para for its nearly half a million square miles (1,300,000 Km^2) of territory.

The situation of Para is shown on map N° 2, an Admiralty Chart, on which are given the Port lines, the channels and the buoying of the route to the ocean. The city of « Belem do Para » (Bethlehem of Para), Lat. 1°-27' South, Long. 48°-30' West from Greenwich, is situated on the right bank of the Para River, which is really an estuary, Para being 65 miles (105 Km.) from the Atlantic Ocean, the deep water of which reaches nearly to the city. The great Island of Marajo, 180 miles (290 Km.) long and 15,000 square miles (38,900 Km^2) in area, separates this estuary from the main Amazon River, although there are deep and navigable channels back of it, between Para and the Amazon, the mouth of which is not used by vessels on account of the dangers to navigation caused by shifting sand bars, changeable channels, a tremendous « bore » which at certain times produces currents impossible to stem and want of good charts, buoys and light ships. By a reasonable amount of dredging the largest ships can come to the quay which is to be built in front of the city and where now are quite a number of small piers where most of the Port traffic is done by lighters from the ships anchored in the estuary below the city. There is a considerable transfer business done at Para between ocean ships and river craft that ascend the Amazon to the Port of Manaos and Iquitos and even much further up the tributaries that lie behind the Andes. It will be seen from the above that Para is naturally the dividing point between the navigation by deep sea and river, a fact that will be still more accentuated by the construction of a modern port with 30.3 feet (9.24 m.) of water alongside the quay and with facilities adapted to the convenient interchange of traffic between ocean and river methods of navigation.

Entering into some further details of location, the City of Para is situated at the junction of the Guajara and Guama Rivers, the city limits extending nearly to Pedreira on the latter stream. Below the mouth of the Guama, the Guajara flows between a cordon of islands on the west and the mainland on the east as far as Mosqueiro Point, where it joins and is lost in the main stream of the Para River. This stretch is known as the Bay of Guajara. The River Guama,

being much larger than the Guajara, influences the current in such a manner that there are formed in the latter stream two channels, one, on the west, along the Island of Onças, and the other, on the east, next to the city. Between these two channels is a shoal, or middle ground, upon which the depth is less than 1.65 feet (0.5 m.) at mean low tide. A bight in the shore along the city front as far as the River Una, together with the shoal above mentioned, forms a bay, within which the port proper is embraced, although the official port extends as far as Forte da Barra, a distance of 5.3 miles (8.5 Km.) from the Castello.

The present depth of water in the port is 19.7 ft. (6.0 m.) at mean low water, but 32.8 ft. (10.0 m.) can be carried from the sea to the mouth of the River Una, a distance of 2 1/2 miles (4.0 km.) from the Castello.

As mentioned above, the Guajara River, in front of the City of Para, has two distinct channels, and the velocity of the current in each is very different. During the months of September, October and November, 1896, Dr. Saboia's Government Commission took a series of current observations in these two channels, with the following results : —

The maximum velocity of the flood current in the west channel was 5.722 ft. (1.744 m.) per second, or 3.9 miles (6.276 km.) per hour, and in the east channel 6.668 ft. (2.097 m.) per second, or 4.7 miles (7.564 km.) per hour ; while the ebb current gave a maximum velocity in the west channel of 5.906 ft. (1.800 m.) per second, or 4 miles (6.437 km.) per hour, and in the east channel a velocity of 3.885 ft. (1.184 m.) per second, or 2.6 miles (4.184 km.) per hour. It will thus be seen that the maximum velocity of the flood current is 20 °/₀ greater in the east than in the west channel, and that of the ebb current is 54 °/₀ greater in the west than in the east channel. It also shows that the maximum velocity of the flood current in the east channel was 81 °/₀ greater than that of the ebb current, while in the west channel the maximum velocity of the flood and ebb currents were almost the same, there being 2 1/2 °/₀ in favor of the ebb. From this it would appear that dependence must be placed mainly on the flood currents for maintaining the depth in the east channel when once the improvements of the Port shall have been completed.

The tidal phenomena at Para were carefully determined by means of a self-registering tide gauge. The record embraced the

months of June to December, 1896, from which the following determinations were made : —

	Feet	Metres
Mean amplitude of all tides.	8.13	2.48
» » neap tide	6.72	2.05
» » spring tide.	9.55	2.91
Minimum amplitude observed.	3.71	1.13
Maximum » »	11.58	3.53
Extreme range of tide	11.68	3.59
Mean H.W. of spring tide above lowest water.	10.27	3.13
Mean L. W. » » » » »	0.72	0.22
Mean H.W. of neap » » » »	8.73	2.66
Mean L. W. » » » » »	2.10	0.64

From the data furnished by the Municipal Commission, the highest water observed occurred on the 29th of March, 1896, attaining a height of 6.86 ft. (2.09 m.) above the mean level of the port, which increases the total amplitude of the port to 12.60 ft. (3.84 m.). Putting this in tabular form we have : —

	Feet	Metres
H.W. March 29th, 1896, above mean water level	6.86	2.09
» » » » above mean low water .	10.92	3.33
Total extreme amplitude of the water	12.60	3.84
Lowest water observed below mean low water. .	1.67	0.51

The duration of the fall is greater than that of the rise, attaining a difference at spring tide of 3 h. 32 m. The mean duration of the rise from June to December, 1896, was 4 h. 7 m. at spring and 5 h. 51 m. at neap. The mean duration of the fall was 7 h. 15 m at spring and 6 h. 35 m. at neap. The period of slack water at H.W. does not exceed 30 m. in either of the two channels, and at L.W. this period is also about 30 m. in the west channel, but in the east channel it has a mean of 1 h. 7 m. and sometimes lasts for 2 h. Notwithstanding the duration and intensity of the flood, the waters of the port are always fresh at all depths and at the lowest stage of the river, as was verified by the commission of Dr. Saboia by numerous samples of water collected in the two channels during the months of October and November, 1896.

The winds at Para blow with the greatest irregularity from between the east and south-east from March to September. However from September to March, they blow from between the east and north-east with perfect regularity from 8 a. m. to 8 p. m., attaining their maximum velocity (19 to 38 miles, or 30 to 60 km., per hour) soon after 2 p. m. when the wind gradually shifts to north north-east or north, forming the well-known « Marajo ». At about 8 p. m. the wind grows less or even becomes calm, and remains so until 7 or 8 in the morning.

After these details of the physical conditions it is necessary to refer to the Contract with the Government for the construction and operation of the Port. Article II is given complete as it defines the works to be executed : —

II

« The present Concession includes the construction of quays and further necessary works in the zone between the junction point of the Oriboco and Guama Rivers and Mosqueiro Point, divided into two sections as follows :

« The First Section, starting from the Castello and going down stream and

« The Second section, starting from the same point and going up stream.

« Each section will be divided into divisions, the construction of which divisions will be undertaken in accordance with the necessities of the Port and according to agreement with the Government.

« The first division will be composed of :

a) Construction of 1,500 metres of quay wall, along which ships may be moored, starting from the Ver-o-Pezo Dock down stream, with the respective ladders and bollards.

b) Filling in of the area included between the said quay wall and the existing shore, including the docks there situated, as well as the space between the Ver-o-Pezo Dock and the Iron Market.

c) Dredging a channel 300 metres wide along the entire extension of the quays, having 6.50 metres (increased to 8 metres) of depth below the mean level of the low water, for the first 500 metres, beginning at the Ver-o-Pezo Dock, for the use of river navigation, and 9.24 metres below the same level for the 1,000 metres following.

d) Dredging of an entrance channel between the division of quay wall above referred to and Mosqueiro, having 200 metres width and 9.24 metres depth, below the mean level of the waters.

e) Construction of a boulevard parallel to the quays 30 metres wide extending from the existing Boulevard da Republica with the proper drainage works.

f) Construction of equipped warehouses along the quays for the deposit of merchandise loaded and unloaded.

g) Construction of a special basin for the service of small boats, with mooring quay, steps and the necessary sheds.

h) Placing of moveable electric cranes along the quays.

i) Placing of bollards, rings and ladders for the passenger traffic and for the crews of ships, and electric illumination, etc.

j) Placing of illuminated buoys in the entrance channel.

k) Furnishing of a floating or fixed crane with a capacity of 30 tons.

l) Furnishing of a tug-boat for the service of buoys and necessities of the Port.

m) Construction of electric tramways behind the warehouses and along the quays.

n) Construction of an electric power station for the production of electric energy for the service of illumination and traction.

o) Construction of a special Depot for explosives and inflammables.

p) Construction of a Coal Depot, equipped for rapid loading and unloading.

q) Construction of buildings for the working of the Custom House, Post Office and National Telegraphs.

r) Construction of a building for the administration and fiscalisation of the Dock Company.

« The Second Division will be composed of 1,000 metres of quays, properly equipped, in prolongation of the first division, starting from the Northern extremity, and shall include the widening to 300 metres of the entrance channel between Mosqueiro and this division of quay walls, the respective dredging to reach the depth of 9.24 metres below mean level of low water. »

The time allowed by the contract for the construction of the first division of the first section is six years from the date of the final approval of all the plans. For the second division the time of

construction depends upon the requirements of the commerce. No doubt the increase of commerce will make the second division necessary at an early date. The principal features of the contract, in addition to those above mentioned, are as follows :

The Port will have all the advantages of the Custom House ports of the Republic, and the Government grants to the Contractor the right to collect the charges specified in the contract for anchorage, dockage, loading, unloading and handling cargo, warehousing, etc., all these dues being specified in the contract or in the laws pertaining to ports. The Company will collect all dues, both port and Custom House, under the supervision of the Custom House Officers, and will turn over to the Government the money received for import duties.

The Custom House Officers will not give permission for the departure of vessels until all dues are paid.

The Contractor can expropriate (condemn) all lands and any existing properties necessary for the construction of the Port and its facilities.

All materials necessary for the construction, operation and maintainance of the work are exempt from import duties.

The Government establishes a special 2 per cent. gold import tax to guarantee six per cent. (6 %) per annum on the amount expended in the works, the same to be in accordance with the Estimate of Cost as it appears in the contract, or as shall be expended in addition by the approval of the Government.

The Capital established in the Concession is 30,942:546$000 gold, (equivalent to £ 3,440,000 or $ 16,894,630 or 87,567,408 francs) for the first division and 26,555:953$000 (equivalent to £ 2,987,540 or $ 14,499,550 or 75,153,350 francs) for the second division. The exchange of Milreis gold is 27 pence (54.6 cents American money or 2.83 francs). The manner of providing for the interest on these sums and also on the amounts expended during construction is best stated in the Contract itself in Article XVI :

« Any strip of quays, final or provisional, can only be put into operation with the anthorisation of the Government.

» Immediately upon the starting of the works in the terms of Article IV and during the period of construction, in which there shall not be any strip of quays in provisional or final operation, there shall be collected of the tax of 2 per cent. gold on the total value of the imports, the part necessary to produce 6 per cent. per

annum on the capital which shall have been semi-annually verified as employed in the works.

» When there shall have been placed in operation any strip of quays, there shall be collected the dues of which the articles of the present Concession treat.

» In case at the end of any year it is verified that, with the application of such dues, the total gross revenue received by the Concessionnaire is less then six sixty-fifths of the capital employed in the works, after the proper amortisement has been deducted, the Government shall permit the collection of the part of the tax of 2 per cent gold on the total value of the imports necessary to produce the 6 per cent. above referred to.

» The same proceedure shall be maintained after the definite placing in operation of all the works. »

Article XXV establishes the following :

« For all of the effects of Article VI, after the inauguration of any strip of quays, final or provisional, there shall be considered :

1. « Gross revenue » — The sum of all the ordinary or extraordinary rates, eventual or complimentary, received by the Concessionnaire.

2. « Net Income » — 65 per cent. of the gross income.

3. « Expenses of Operation » — 30 per cent. of the gross income after providing for the payment of the amount for fiscalisation to which Article XXI refers, and the expenses necessary for the services and maintainance of the port and its dependencies in the terms of the present Concession, and in addition 5 per cent. of the gross income destined especially for the maintainance, illumination and improvement of the entrance channel between Mosqueiro and the quays. »

The general layout of the works is shown on sheet N° 4 : The line of the quay, the tracks, the location of cranes, the warehouses, the boulevard and the basin with steps for small boats appear on this plan. The method adopted for the construction of the quay wall proper is that of sloping concrete block-work, the blocks weighing from 20 to 30 tons. The blocks are to be furnished with « joggle » holes so as to permit of joggle bags filled with concrete of the same quality as that of which the blocks are made, being inserted to act blocks, maye be built of either concrete as a key between them.

The top of the wall, above the sloping blocks may be built either of concrete blocks or mass concrete. The elevation and section of a characteristic portion of the wall is shown on sheet N° 5. The character of the material, as found by careful borings made along the line of the proposed quay wall, is shown on the profile (sheet No. 3). This material requires an artificial foundation, the clay generally not being sufficiently resistant to support the wall with only a base of riprap stone underneath. For this reason a pile foundation has been resorted to, with riprap and mass concrete to solidify the base and hold the piles in place.

The extensive area lying between the quay wall and the shore will be filled in with first an enrockment of riprap stone backing up the quay wall and then sand, that under the warehouses being specially selected. This sand will be dredged from the shoal lying between the quay wall and the Island of Onças and distant from the quay wall from 600 to 1,500 metres. All the dredging from the channel and foundations will be deposited away from the port area (unless good sand is encountered in sufficient quantities), and from one to three miles distant from the point where the dredging is done.

One of the most interesting, as well as important, features of the new port is the warehouses and electric cranes. These are indicated as to location on sheet No. 4, the plan and elevations of the same on sheet No. 5 and one of the ordinary cranes on sheet No. 6. There will be two 5-ton and one 30-ton fixed cranes as shown on sheet No. 4. The plan of the 30-ton crane is shown on sheet No. 7. The warehouses will be provided with tracks, turn-tables, electric moveable hoists and will be smoothly and solidly paved, with concrete. All areas will be well paved, generally with « belgian » blocks, and the Boulevard will be paved with asphalt.

A coal-handling plant of the most approved modern type will be built either at the down-stream end of the first division or elsewhere where it will be convenient for steamships and where the coal dust will not be troublesome. The location of two fire-proof warehouses for inflammables has not yet been determined. It will be either on the Island of Onças with a pier for lighters or at some accessible point down the river and connected with the Port and city by rail or water. The location and plans of the Custom House and building for the Port offices are not yet determined upon, but it will be where investigations show them to be most convenient for the

purpose and they will be in any event buildings of fine architecture and adapted to the climate and the business to be transacted in them.

A large future commerce, when once the works are completed and operations are commenced with the improved facilities, is assured to the Port. The facts already given are evidence sufficient to prove the case, but outside of the normal increase, amounting to the difference between about 1,000,000 registered tons in 1902 and 1,900,000 in 1905, due to the demand for the exportable products of the country, are the still more important conditions caused by the improvement of the facilities for handling the traffic.

The author has recently made the most extensive and thorough investigation to ascertain the law of the growth of ports due to improvement of commercial facilities and there is no question of the rapid increase wherever there has been such enlargement and improvement, assuming general conditions of commerce to be satisfactory. As pertinent to this subject, there may be quoted the great increase of commerce at Buenos Aires, Argentine, from 650,000 registered tons of entrances and clearances in 1885, at the time the new port was designed, to nearly 12,000,000 in 1905, an increase not altogether due to the improvement in commercial facilities, but still in great part due to it. The facilities furnished by a port costing nearly $ 40,000,000 (£ 8,224,400 or 207 millions 254,000 francs) and finished only in 1899, is already inadequate to accomodate the commerce which itself has largely produced. The author has likewise made an investigation into the cost of operating conveniently arranged ports and he finds it to average much less than the 35 per cent. of the gross revenue allowed in the Concession, it generally varies from 21 per cent. to 35 per cent.

A careful estimate of the business of the Port of Para, had it been completed and in operation in 1905, with the traffic of that year and with the dues allowed in the Concession, shows that the gross revenue would have been £ 478,500 ($ 2,330,300 or 12,058,200 fr.), the expenditures £ 168,684 ($ 821,500 or 4,250,840 francs) and the net income £ 309,816 ($ 1,508,800 or 7,807,360 francs). It is reasonable to expect in 1912, when the works will be completed, double the figures of traffic and revenue above given. The natural increase of the commerce in the seven years, added to the increase due to better facilities and less costly handling of cargoes, and when large ships may lie alongside the quay and handle their traffic by the Port cranes, will easily double the income.

The author has given now the general features and some of the details of the new Port of Para, undertaken by a North American Company and to be built by English and French Contractors in the South American Country of Brazil, — certainly an international work.

This communication is written with the hope that it will interest not only hydraulic engineers but navigation companies, Chambers of Commerce and the Governments of the world who are interested in the International Navigation Congresses and in the important work this Organization has undertaken to do in giving information to all interested in navigation subjects.

Chalon-sur-Saône, France. December 29, 1906.

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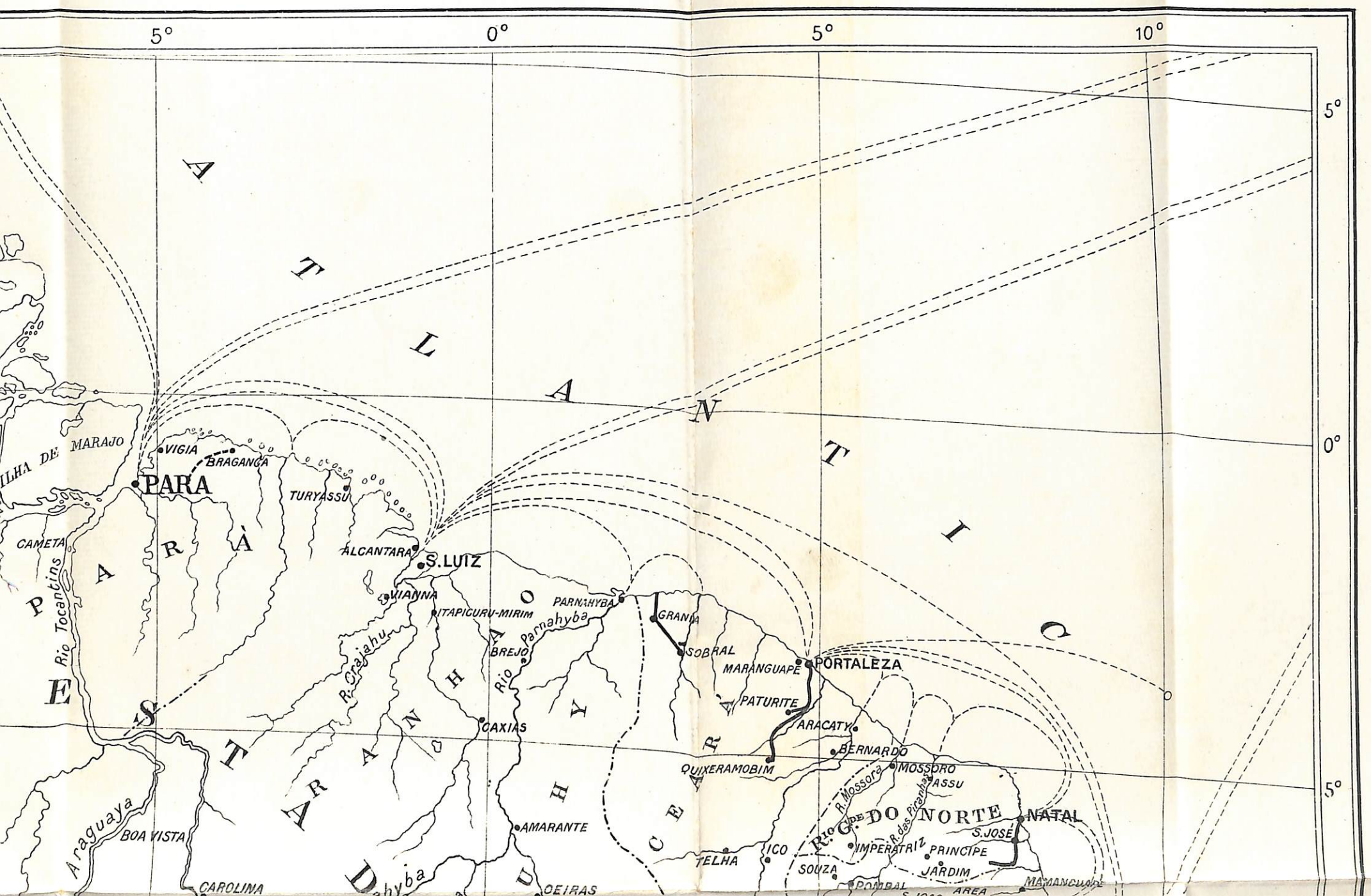
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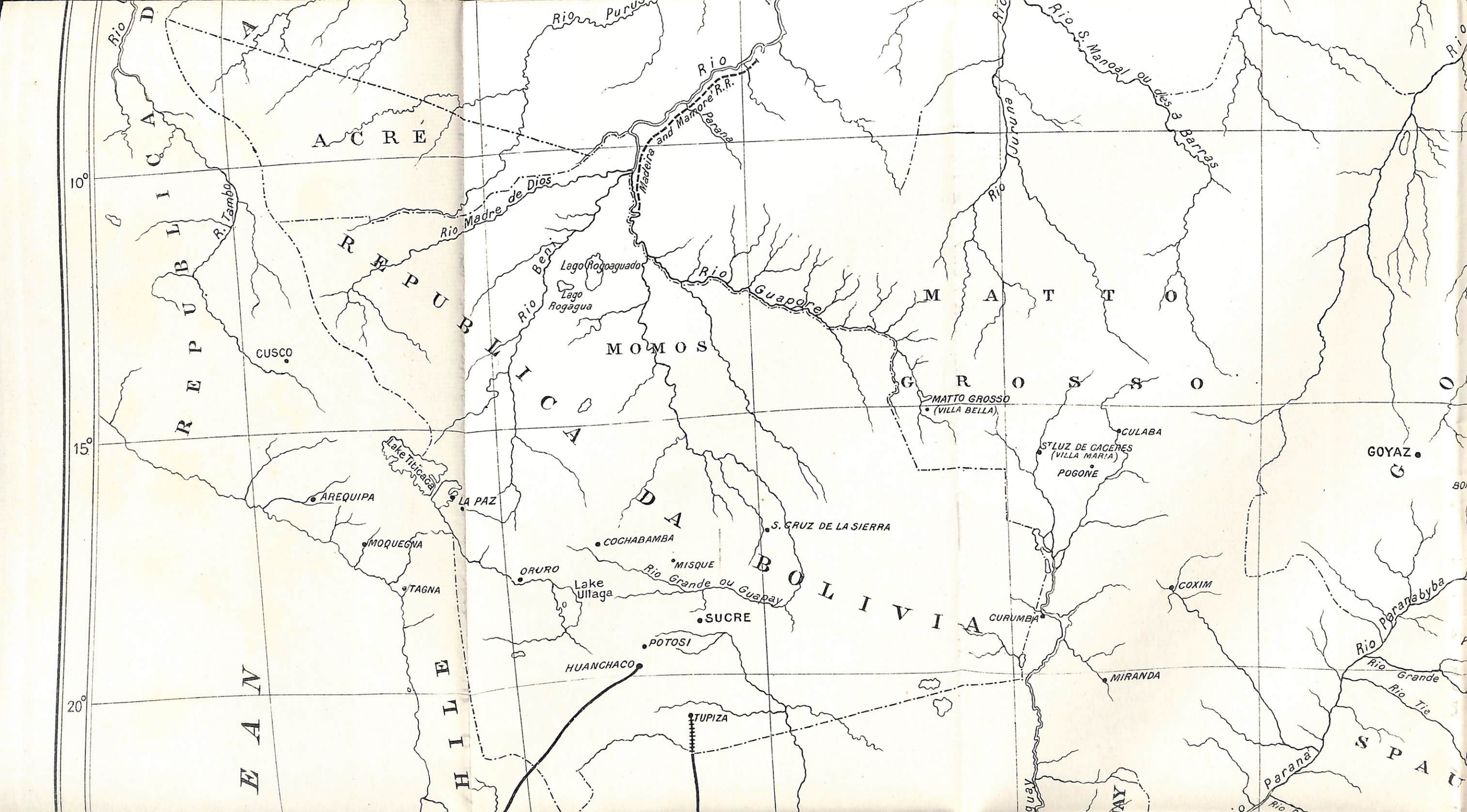
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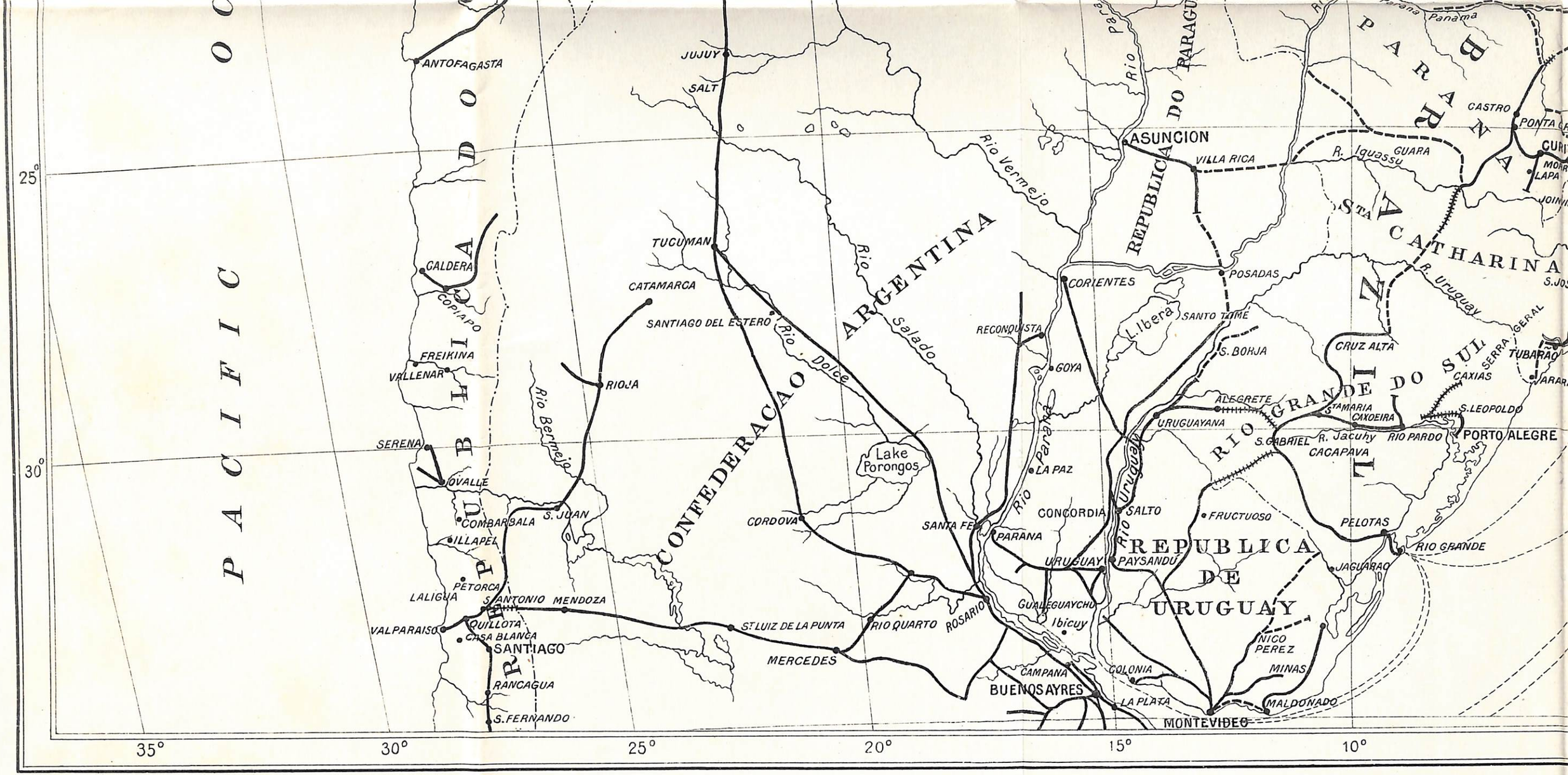
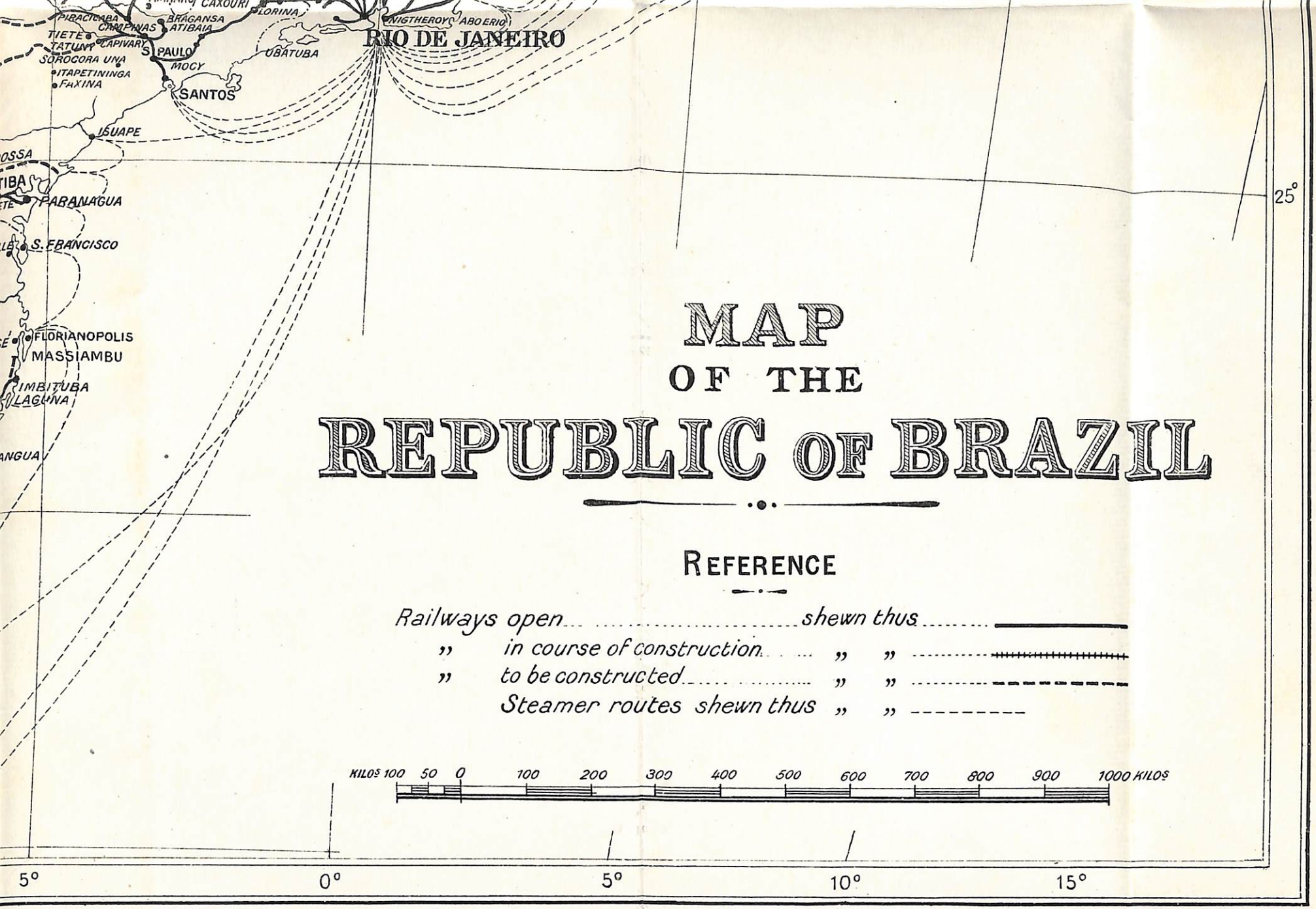
AMARO
CAXDEIRO
MARAGOSIPE
NAZARETH
VALENÇA
BAHIA
PORTO IMPERIAL
PALMA
Rio Maranhão
Rio S. Francisco
Rio Parnahyba
Rio Curuciá
JANUARIA
S. FRANCISCO
RIO PARDO
STLUZA
BOMFIM
GRAO MOGOL
Jequitinhonha
Rio
ARASSUHAY
PARACATU
MINASHOVAS
CATALAO
S. JOÃ BAPTISTA
CARAVELLAS
CAMPOGRANDE
THEOPHILO OTTONI
DIAMANTINO
BAGAGEM
ARGURY
PATROCINIO
CORVELO
SERRO
PECANHA
S. MATHEUS
PRATA
ARAXA
ABAETE
CONCEICAO
Rio Doce
UBERABA
PITANGUY
STA LUZIA
ITABIRA
DESENBOQUE
S. ANTONIO
SABARA
OURO PRETO
SERRA
VICTORIA
FRANCA
FORMICA
ZAMANDUA
OLIVEIRA
QUELUZ
PONTE NOVA
S. LUZIA
PARAIZO
BATATAES
BOM SUCCESSO
TURVO
RIBEIRAO
FRETO
ALFENAS
MOCOCA
LAVRAS
JOÃO DEL REI
LEOPOLDINA
TRES PONTAS
ARABAQUARA
CASA BRANCA
CAMPANHA
JUIZ DE FORA
S. JOÃO DA BARRA
ESPERITO SANTO
BAHEPENDY
AYURUOCA
RIO PRETA
CANTAGALLO
ARARAS
RIO CLARO
CHRISTINA
MOGO MIRIM
ITAJUBA
RIO DE JANEIRO
LIMEIRA
AMBARO
CAXOURI
MACAHE
PIRACICABA
BRAGANSA
FLORINA
NIGTHEROY
ARARIPE
ESPIRITO SANTO
MINAS GERAES
S. PAULO
ASSOCIAÇÃO
ZONA
BAHIA
OCEANO
10°
15°
20°


PACIFIC OCEAN
ANTOFAGASTA
JUJUY
SALT
TUCUMAN
CATAMARCA
SANTIAGO DEL ESTERO
CALDERA
COPIAPO
FREIKINA
VALLENAR
RIOJA
SERENA
OVALLE
COMBARBALA
ILLAPEL
PETORCA
LALIGUA
S. JUAN
S. ANTONIO
MENDOZA
VALPARAISO
QUILLOTA
CASA BLANCA
SANTIAGO
RANCAGUA
S. FERNANDO
CORDOVA
ST LUIZ DE LA PUNTA
RIO QUARTO
MERCEDES
ROSARIO
SANTA FE
Lake Porongos
CONFEDERACAO ARGENTINA
REPUBLICA DE CHILE
Rio Bermejo
Rio Dolce
Rio Salado
Rio Vermejo
Rio Paraná
Rio Uruguay
ASUNCION
VILLA RICA
CORIENTES
POSADAS
RECONQUISTA
GOYA
LA PAZ
PARANA
CONCORDIA
SALTO
URUGUAY
PAYSANDU
GUALEGUAYCHU
Ibicuy
BUENOS AYRES
CAMPANA
LA PLATA
COLONIA
MONTEVIDEO
FRUCTUOSO
PELOTAS
RIO GRANDE
JAGUARAO
MALDONADO
NICO PEREZ
MINAS
REPUBLICA DE URUGUAY
REPUBLICA DO PARAGUAY
PARANA
CASTRO
PONTA
CURITIBA
MORRETES
LAPA
JOINVILLE
STA CATHARINA
S.JOSE
R. Iguassu
GUARA
R. Uruguay
SERRA GERAL
TUBARAO
L. Ibera
SANTO TZIME
S. BORJA
CRUZ ALTA
CAXIAS
ALEGRETE
URUGUAYANA
STA MARIA
CAXOEIRA
S.LEOPOLDO
S.GABRIEL
R. Jacuhy
RIO PARDO
PORTO ALEGRE
CACAPAVA
RIO GRANDE DO SUL
25°
30°
35°
20°
15°
10°



MAP
OF THE
REPUBLIC OF BRAZIL

REFERENCE

Railways open ..... shewn thus .....

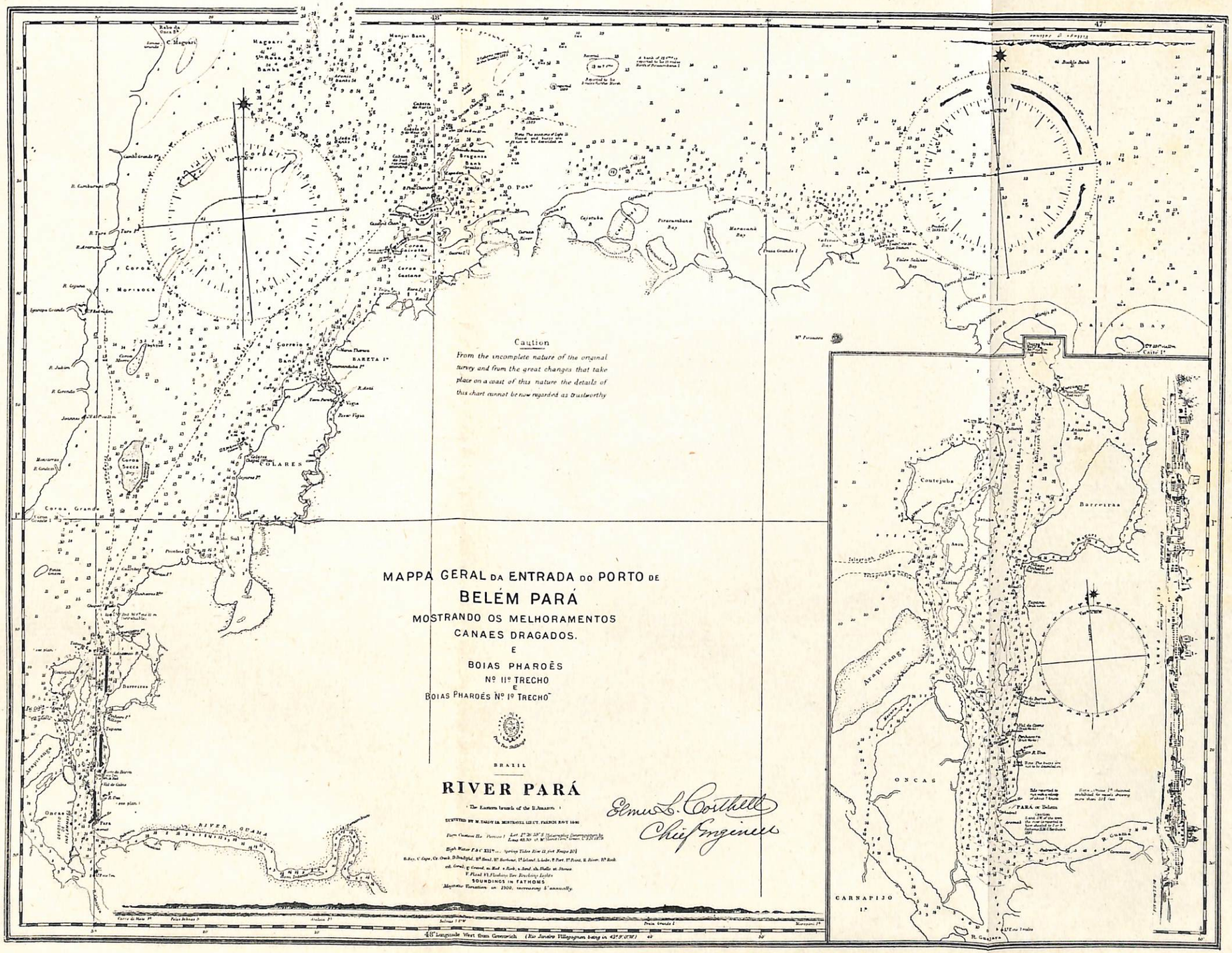
" in course of construction ..... " " .....

" to be constructed ..... " " .....

Steamer routes shewn thus " " .....

KILOS 100 50 0 100 200 300 400 500 600 700 800 900 1000 KILOS

PROVINCIA DI TORINO


Caution
From the incomplete nature of the original survey and from the great changes that take place on a coast of this nature the details of this chart cannot be now regarded as trustworthy
MAPPA GERAL DA ENTRADA DO PORTO DE
BELÉM PARÁ
MOSTRANDO OS MELHORAMENTOS
CANAES DRAGADOS.
E
BOIAS PHAROÈS
Nº 11º TRECHO
E
BOIAS PHAROÈS Nº 1º TRECHO
BRAZIL
RIVER PARÁ
Elmer L. Corthell
Chief Engineer
Caripi Bay
Barreiras
Coutejuba
ARAPIJADEA
ONCAS
CARNAPIJO
PARÁ or Belem
COLARES
Corôa Grande
Corôa Seca
Barreta 1º
Morisoca
Corôa
Correio
Maguari
Manjuri Bank
Bragança Bank
O Poço
Pirarambara Bay
Marauaná Bay
Caripi
Virgia
River Virgia
R. Guajara
R. Guama
RIVER GUAMA
Ilha de Outeiro
Ilha de Cotijuba
Ilha de Jutuba
Ilha de Mosqueiro
Ilha de Caratateua
Ilha de Caratateuasinho
Ilha de Murutucú
Ilha de Jutuba
Ilha de Arapijó
Ilha de Jutuba Pequena
Ilha de Jutuba Grande
Ilha de Jutuba Pequena
Ilha de Jutuba Grande
Ilha de Jutuba Pequena
Ilha de Jutuba Grande

PROVINCIA DI TORINO

IMPROVEMENTS IN THE PORT OF BELEM

(Melhoramentos do Porto de Belem)

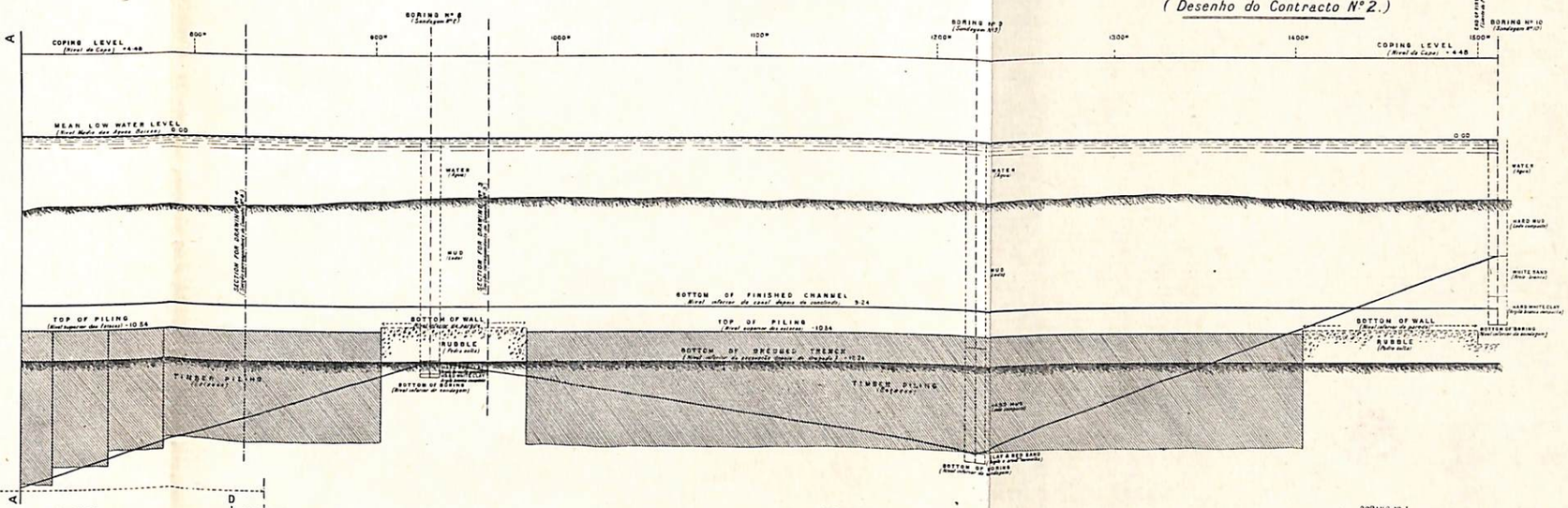
PARA.

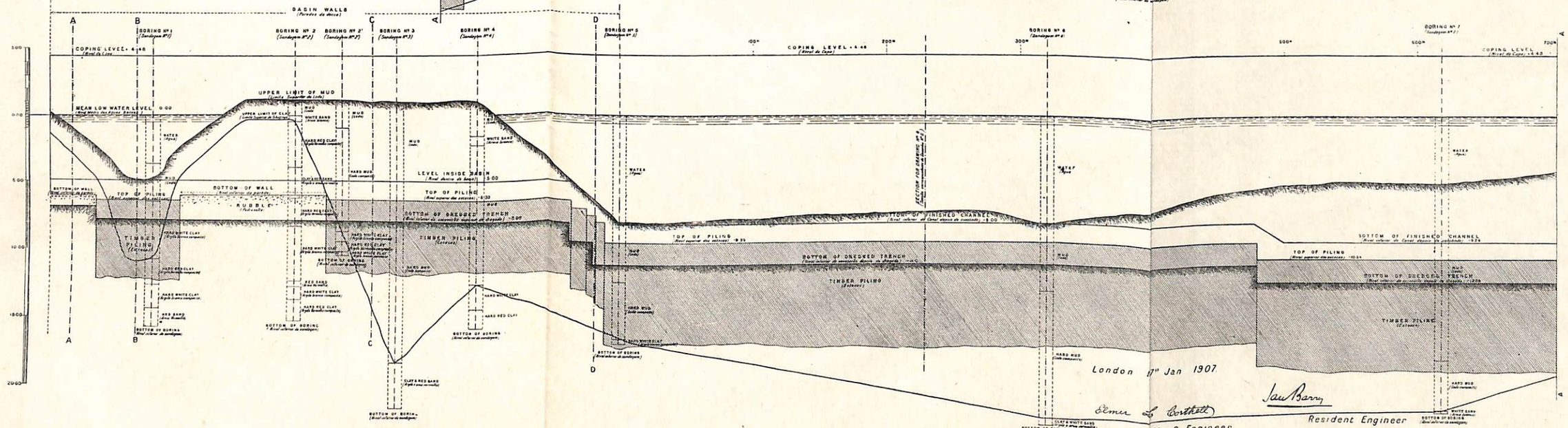
(Desenho do Contracto N° 2.)

LONGITUDINAL ELEVATION OF THE WALL
WITH BORINGS

(Perfil ao longo da parede e sondagens)

SCALE (Escala) { VERTICAL 1 : 100 / HORIZONTAL 1 : 1000





London 17th Jan 1907

Elmer L. Corthell
Chief Engineer

Jas Barry
Resident Engineer

PROVINCIA DI TORINO

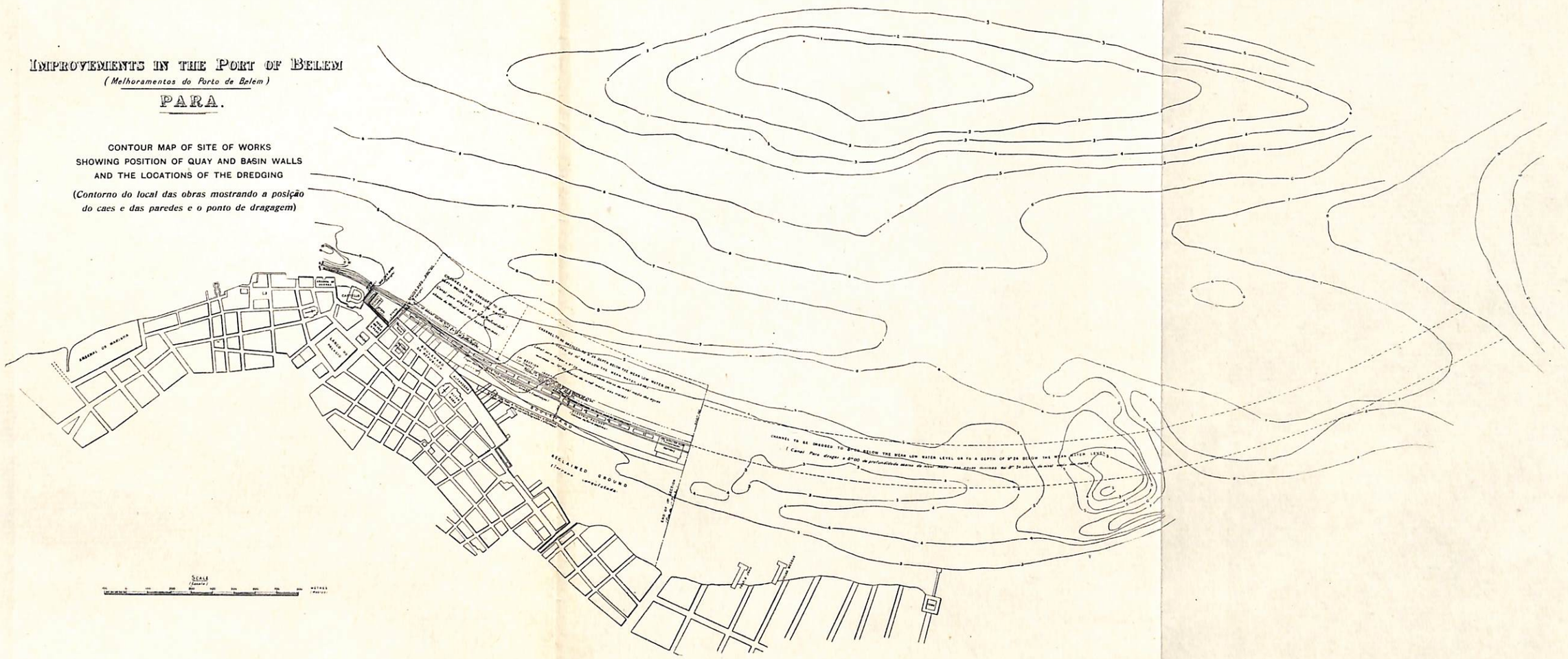
IMPROVEMENTS IN THE PORT OF BELEM

(Melhoramentos do Porto de Belem)

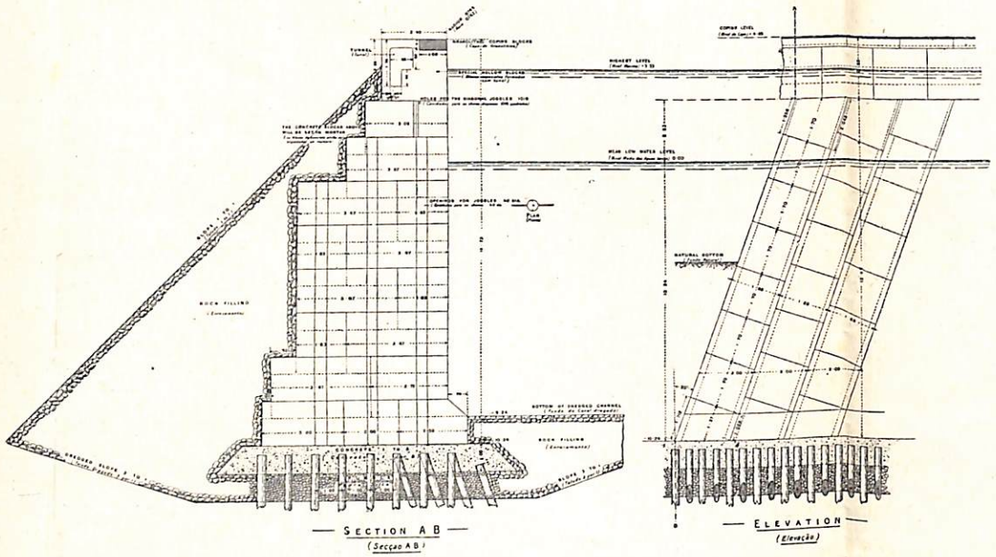
PARA.

CONTOUR MAP OF SITE OF WORKS
SHOWING POSITION OF QUAY AND BASIN WALLS
AND THE LOCATIONS OF THE DREDGING

(Contorno do local das obras mostrando a posição do caes e das paredes e o ponto de dragagem)

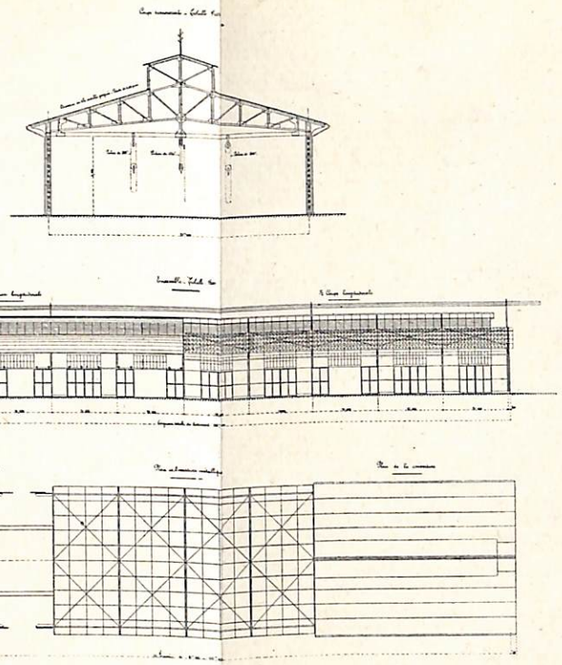

RECLAIMED GROUND
Terrenos conquistados
CHANNEL TO BE DREDGED TO 8·84 BELOW THE MEAN LOW WATER LEVEL OR TO A DEPTH OF 9·24 BELOW THE MEAN WATER LEVEL
SCALE

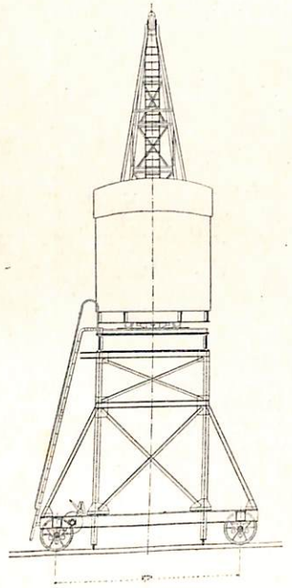
PROVINCIA DI TORINO

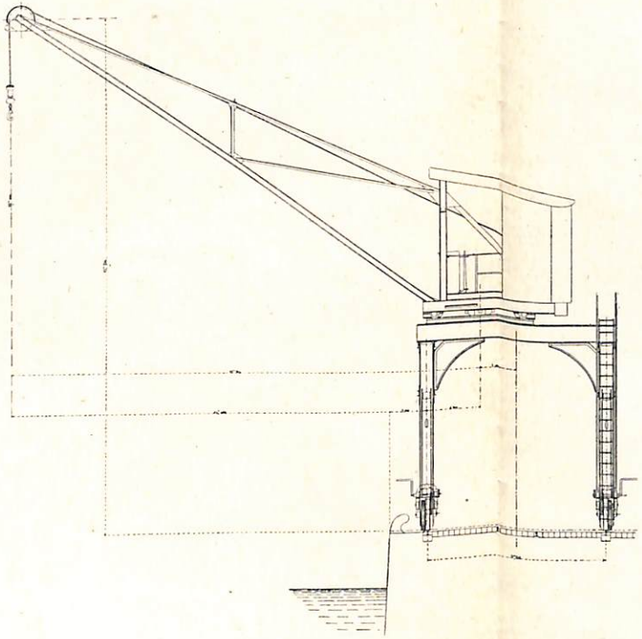


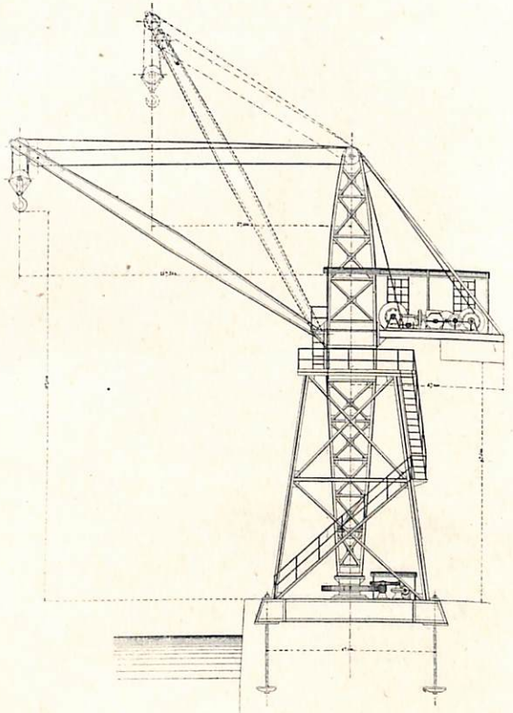
— SECTION A B —
(Secção A B)

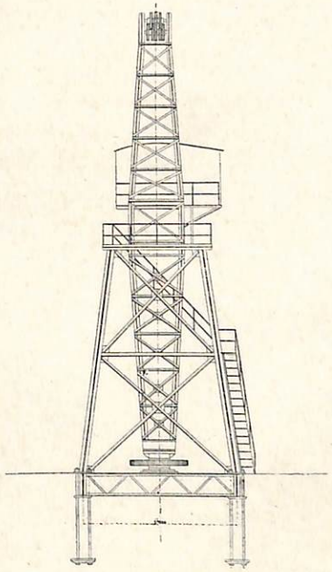
— ELEVATION —
(Elevação)











PROVINCIA DI TORINO